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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application Serial No.	09/888,214
Filing Date	June 21,2001
Inventor	Frank Melzer, Ulrich Bingel
Assignee	Carl Zeiss SMT AG
Group Art Unit	2872
Examiner	R.D.Shafer
Attorney' Docket No.	LO25-003

Title: Method of Connecting a Multiplicity of Optical Elements to a Basic Body

Declaration of inventor under 37 C.F.R § 1.132

1. I, Ulrich Bingel, Dipl.-Ing.(FH)
   Hirtenteichstrasse 3, 73457 Lauterburg, Germany
   am one of the inventors of the above referenced application US Ser. No. 09/888,214 filed June 21, 2001

2. I received a degree as a graduate engineer in surface technology and materials science from the advanced technical college at Aalen, Germany (Diplomingenieur (FH) Oberflächentechnik und Werkstoffkunde from Fachhochschule Aalen) in February, 1990.

   I am currently a postgraduate student of materials science (Werkstoffwissenschaften) at the mining academy (Bergbauakademie) at Freiberg/Saxonia.

3. Since November 1989 I was employed by Carl Zeiss at Oberkochen, Germany as head of experimental galvanic group of the research and technology department.

   There I was inter alia occupied with galvanoplastic manufacture of x-ray mirrors for space telescopes and supervision of manufacture of mandrels (negative forms) for such mirrors and with the development of special galvanic coatings.

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- Subsequently since January 1999 I worked in the production service unit of the same firm, supervising galvanic production and galvanic prototyping, This included development work, inter alia galvanoforming and analytical and practical work.

- Subsequently since October 2000 I was employed by Fraunhofer Institute for Manufacturing Engineering and Automation IPA, department of surface technology, in Stuttgart, Germany. There I was occupied with a broad range of projects in galvanic technology, inter alia in the manufacture of neutron mirrors by copper galvanoforming. 17.08.04. UB

- Subsequently since April 2003 I am employed by Carl Zeiss Laser Optics GmbH, Oberkochen, where I am occupied with development and laboratory production of optical components like extreme ultraviolet mirrors using galvanoforming.

4. During all my above cited activities I was occupied with scientific and research work:
   a) My Diploma thesis in 1989 was titled:
   "Manufacture of an aluminium galvanoplastic in non-aqueous solvents"
   b) Some of my publications are:

   (1) "Mirror system for the German x-ray satellite ABRIXAS: I. Flight mirror fabrication, integration, and testing"
   Altmann, J.; Egle, W.J.; Bingel, U. et al. Proc. SPIE Vol. 3444 (1998), p. 350 – 358.

   (2)" Herstellung eines Neutronenspiegels mittels Galvanoformung"
   (Manufacture of a neutron mirror by galvanoforming)
   Wolf, O., Bingel, U. et al.
   Fachzeitschrift Galvanotechnik (1999), 1845 Leuze Verlag, Gennany (in German)

   (3) „Production and testing of development mandrels for Constellation-X"

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Egle, W. et al.; Bingel, U.
Proc. SPIE Vol. 4012 (2000), p. 548 – 558. (NASA contract No. NAS 8-99245)

c) I have made a number of inventions:
See enclosed list of 14 published applications of 12 different inventions including the one addressed here (no. 11)

5. The examiner has raised questions about the proper understanding and teaching of the specification, paragraph [0025] on p. 6, of my above cited application.
This reads:

a) " 0025 The mirror elements 9 placed on the basic body 8 are connected to the basic body 8 by a galvanoplastic joining technique, as indicated by an intermediate layer 10 between the mirror elements 9 and the basic body 8."

This is a proper translation of my original German text p. 6, 3rd paragraph of priority document:

„Die auf den Grundkörper 8 aufgelegten Spiegelelemente 9 werden durch ein galvanoplastisches Fügen mit dem Grundkörper 8 verbunden, wie dies durch eine Zwischenschicht 10 zwischen Spiegelelement 9 und dem Glaskörper 8 angedeutet ist."

b) From the context and the reference numerals it is clear, that this text is related to the drawing fig. 2.

I understand this fig. 2 as a schematic sketch which is not representing an exact binding construction, but which is an illustrative aid for understanding.

c) The word "indicated" – translated from "angedeutet" is understood by me like synonyms "hint" or "suggest" (see LEO translation of "andeuten") in the same way as an illustrative aid for understanding.

d) The word "layer" addresses the fact that Galvanoplastic articles are of a generally flat extended shape, as the production occurs generally by an increasing thickness over a mold (mandrel). It is typical that this process leads to rounded out and thickened portions at the back side of edges of a mold.

e) The words "intermediate" and "between" are translated from the same German word "zwischen", where "intermediate layer" is lexically found as a one-to-one translation (encl.) of "Zwischenschicht" and "between" is a very normal translation of "zwischen".

Now the enclosed "Merriam Webster Online Dictionary" entry "between" shows as 3b the meaning that is relevant here: serving to connect.

f) Those skilled in the art of Galvanoplastic (i.e. galvanoforming, electroforming) reading the cited paragraph [0025] in the context of my application surely would not interpret "between" according to 2a of said dictionary to read " in the space that separates" which would mean that basic body 8, intermediate layer 10 and mirror elements 9 would be stacked one above the other (sandwiched). This would contradict the first part of the same sentence "mirror elements 9" placed on the basic body 8 and the showing of Fig. 2 (original), where basic body 8 and intermediate layer 10 are hatched , so that they show to be in sectional view, while mirror elements 9 are not, so that they are shown in side elevational view. So this drawing cannot be understood as a cross-section of a stacked arrangement, but mirror elements are located behind the plane of drawing – and behind the intermediate layer.

g) Consequently I am sure, that our specification clearly teaches the specialist in Galvanoplastics to make a joining, which in a cross section orthogonal to the one of Fig. 2 looks like the schematic sketch of Fig. 2b filed in February 2004.

The specialist would not consider a spacing between mirror elements 9 and basic body 8, but these touch each other, and galvanoplastically made intermediate layer 10 will

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fill
~~fie~~ the interspace between the different mirror elements 9 (note plural) and the basic body 8 surface where not covered by one of the mirror elements 9. So a joining "between" the mirror elements 9 and the basic body 8 will be established, as the galvanoplastic intermediate layer 10 will adhere to the covered surfaces.

h) The specialist knows how to as certain that the mirroring surfaces of mirror elements 9 are not inadvertently covered by a galvanic deposit. Only conductive surfaces get covered by galvanic deposits. Paragraphs [0015] and [0028] - primarily related to the 2nd embodiment, but combinable with the first according to paragraph [0033], first sentence teach that either a surface (metallic) is protected by a (non-conductive) cover or a (non-metallic) body is selectively made conductive only where desired.

So it is no problem for the specialist to keep the galvanic deposit off the mirroring surfaces. Such structured conductive surface of a substrate for galvanoplastics is described in my patent US 6,166,868, col. 2 l. 56 – 67.

6. From all these aspects 5. a) – g) it is my firm belief and understanding, that those skilled in the art of Galvanoplastics are provided with an enabling disclosure as to how to connect a plurality of individual optical elements (mirrors) to a basic body, by a galvanoplastic joining technique

A word-by-word interpretation of paragraph [0025] leading to a sandwich/stack configuration would not be considered by those skilled in the art and would not distract them from adequate use of their skill and of our complete specification.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and, further, that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code and that such willful false statement ~~may~~ may jeopardize the validity of the application or any patent issued thereon. 17.08.04. UB.

8. August 2004
Date

Ulrich Bingel
Inventor: Ulrich Bingel

Abstract

PUBLICATIONS

Mirror system for the German x-ray satellite ABRIXAS: I. Flight mirror fabrication, integration, and testing

Altmann, Juergen, Egle, Wilhelm J., Engel, Ulrich, Hafner, Wolfgang, Gaenswein, Bernhard, Schwarz, Herbert, Neugschwender, Anton, Carl Zeiss

Publication: Proc. SPIE Vol. 3444, p. 350-358, X-Ray Optics, Instruments, and Missions, Richard B. Hoover; Arthur B. Walker; Eds.

Publication Date: 11/1998

Abstract:
The tight ABRIXAS program schedule requires 250 mirror shells to be produced, checked and accepted within one year. This means that the fabrication processes have to be fully understood and kept completely under control. This applies mainly for the major production steps, like gold-coating of the mandrels, Nickel electroforming, mirror shells release from the mandrels and mirror shells testing and acceptance. We will report about the way how we tackled these technical and logistic challenges. Another important step for the optical performance of ABRIXAS Mirror Modules is the integration of the 27 mirror shells in the structural parts. This process requires high skill and good control means, like optical collimator, CCD camera and sophisticated analysis tools in order to achieve optimal-co-alignment of the 27 mirror shells axes and best confocality. This is guaranteed by dedicated test-facilities and sophisticated analyses software. We will report about the results obtained on integrated single mirrors shells as well as on the assembly of all 27 mirror shells.

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Galvanotechnik
D-88348 Saulgau
90 (1999) Nr. 7

Herstellung eines Neutronenspiegels mittels Galvanoformung *

Von Dipl. Ing. (FH) Oliver Wolf, Fachhochschule Aalen, Studiengang Oberflächentechnik und Werkstoffkunde; Dipl.-Ing. (FH) Ulrich Bingel und Dipl.-Phys. Wilhelm Egle, Carl Zeiss Oberkochen; Prof. Dr.-Ing. Johanngeorg Otto und Prof. Dipl.-Ing. Peter Kunz, Fachhochschule Aalen

1 Einleitung

Bereits vor über 30 Jahren begann man mit Untersuchungen zu einer fokussierenden Kleinwinkelstreuapparatur für streifend einfallende Neutronen, *SANS* (Small-Angle Neutron Scattering). Hochauflösende Instrumente verwenden bisher herkömmliche Lochblenden-Kameras. Dabei nehmen diese mit bis zu 80 m Länge sehr große Ausmaße an. Verwendet man eine Fokussiereinrichtung, so kann die Länge der Apparatur wesentlich verkürzt werden. Das scheiterte bisher an der mangelnden Qualität der optischen Komponenten. Ein weiterer Vorteil des fokussierten Neutronenstrahls ist seine größere Intensität.

Durch galvanische Abformung auf einer Zerodur-Form soll nun ein Ellipsoidspiegel mit folgenden Eigenschaften angefertigt werden:

- Brennweite f = 10.000 mm
- Durchmesser d = 275,2 bis 400 mm
- Länge l = 600 mm
- Mikrorauhigkeit = 0,3 bis 0,5 nm
- Wanddicke s = 1 mm
- Gewicht = ca. 4,6 bis 6,7 kg

Untersuchungen an einer ähnlichen Apparatur in Grenoble erbrachten bereits erfolgversprechende Erkenntnisse [20].

Abbildung 1 zeigt schematisch den Aufbau einer fokussierenden Kleinwinkelstreuapparatur. An der linken Eingangsblende tritt ein Neutronenstrahl mit einer Wellenlänge von größer 1,5 nm ein. Durch den *Beam Stop* wird verhindert, daß der Hauptstrahl direkt auf den Detektor einfällt. Dies würde zu einer starken Streuung führen, die den Untergrund erhöhen würde. Durch Verwendung des *Beam Stops* kann der Untergrund um den Faktor vier verbessert werden.

Der am Spiegel reflektierte Strahl durchdringt die Probe am rechten Spiegelausgang. In der Probe werden die Neutronen gestreut und treffen auf einen Detektor, über welchen die Auswertung erfolgt.

Ein besonderer Punkt des Neutronenspiegels ist die Reflexionsschicht. Ein Optimum wäre erreicht, wenn sich der Neutronenstrahl genauso wie reflektiertes Licht verhalten würde. Deshalb ist eine sehr hohe optische Qualität der Spiegelschale erforderlich. Es ist bekannt, daß Neutronen eine sehr starke Wechselwirkung mit magnetischen Stoffen eingehen. Die Wechselwirkung ist noch stärker als bei Licht. Schon kleine magnetische Domänen würden zu einer diffusen Streuung der Neutronen führen, was wieder zu einer Erhöhung des Untergrunds bei der Messung führen würde. Deshalb dürfen nur nichtmagnetische Materialien, wie z. B. Kupfer, verwendet werden.

Eingesetzt werden solche *SANS*-Apparaturen zum Teil bei der physikalischen Grundlagenforschung, aber auch konkret für Werkstoffuntersuchungen. Hauptgebiete ist da die Untersuchung der Eigenschaften von Polymeren [19 - 21].

2 Problemstellung und Lösungsweg

Ziel der vorliegenden Diplomarbeit war es, eine Technologie für die Herstellung des beschriebenen Neutronenspiegels für das Forschungszentrum Jülich zu entwickeln. Da eine mechanische Fertigung aufgrund der dünnen Wandstärke von 1 mm und der geforderten Genauigkeit nicht realisierbar war, wurde als Herstellverfahren Galvanoformung gewählt. Auf einen Abformkörper (engl. = Mandrel), der die exakte Negativform der Spiegelschale hat, wird galvanisch eine dicke Schicht

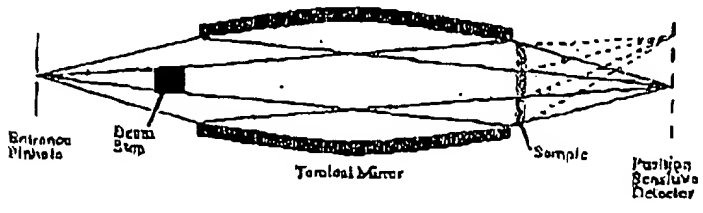

Abb. 1: Schematischer Aufbau einer fokussierenden Kleinwinkelstreuapparatur

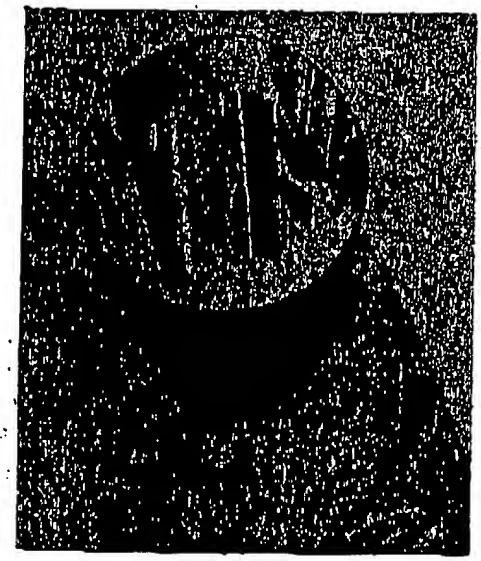

Abb. 15: Getrennte Spiegelschale

untere Meßgrenze der Vermessungsapparatur. Im Vergleich dazu liegt der geforderte Sollwert der *ABRIXAS*-Schalen aus Nickel bei 20 Bogensekunden.

Die Gewichtsbestimmung der Schale ergab 770,48 g. Aus den Maßen der Spiegelschale und der Dichte von Kupfer läßt sich daraus die mittlere Schichtdicke von 1,24 mm berechnen.

6 Zusammenfassung

Mit den Versuchen konnte eine nahezu von inneren Spannungen freie Kupferschicht abgeschieden werden. Dabei wurden Versuche mit Gleichstrom und gepulstem Strom sowie unterschiedlichen Stromdichten durchgeführt.

Es ließ sich zeigen, daß man über die Stromdichte einen wesentlichen Einfluß auf die inneren Spannungen ausüben kann. So war ein Anstieg der Zugspannungen bei steigender Stromdichte zu beobachten. Bei sinkender Stromdichte gingen die Zugspannungen zurück, beziehungsweise in den Druckbereich über. Durch den Einsatz von gepulstem Strom konnten noch bessere, d. h. spannungsärmere Schichten abgeschieden werden.

Bei der Pulsstromabscheidung machte sich auch eine starke Abhängigkeit des Schichtaufbaus von der Pulsform deutlich. Je nach Pulsform wurden Abscheidungen erhalten, die für die Anwendung nicht zu gebrauchen waren. Durch gezielte Variation konnten diese Effekte aber unterdrückt werden.

Die Untersuchungen der mechanischen Eigenschaften zeigten, daß gegenüber den Normalwerten von Kupfer eine höhere Härte und höhere Zugfestigkeit erreicht wurden.

Durch Tempern eines Probespiegels sollte festgestellt werden, ob es zu einer Diffusion von Kupfer und Nickel ineinander kommt. WDX-Untersuchungen zeigten, daß es bei den gegebenen Bedingungen zu keiner Diffusion kam.

Es wurde eine Spiegelschale aus Kupfer (*ABRIXAS*-Mandrel # 27) hergestellt. Die leichte Trennbarkeit vom Mandrel bestätigte die geringen inneren Zugspannungen in der Kupferschicht. Die mittlere Schichtdicke betrug 1,24 mm. Der visuelle Eindruck der Schale war sehr gut. Die optische Vermessung lieferte hervorragende Werte, welche die Anforderungen in jeder Hinsicht erfüllen.

Mit den in dieser Arbeit gewonnen Erkenntnissen ist es möglich größere Spiegelschalen von sehr hoher Qualität anzufertigen.

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Production and testing of development mandrels for Constellation-X

Authors: W. Egle*, J. Altmann, W. Hafner
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G. Derst, H. Hoefer, U. Bingel
Carl Zeiss, 73446 Oberkochen, Germany

ABSTRACT

Two identical Wolter type 1 mandrels, with 50 cm diameter and 8.4 meter focal length, to be used by NASA/MSFC for their Constellation-X mirror development program, have been produced and tested by Carl Zeiss. In August 1999, both mandrels have been delivered to MSFC.

Key optical performance of both mandrels:

- On – axis HEW: < 3.2 arc sec
- Micro-roughness: better than 0.30 nm RMS

We will report about mandrels design, fabrication, test and verification of their X-ray optical performance.

Key words: X-ray optics, Wolter 1 mandrels, Constellation-X

1 INTRODUCTION

Constellation-X is one of the next X-ray missions planned by NASA.

A fleet of 4 spacecraft, each having a single, powerful X-ray telescope on board, shall be operated in one Lagrange point of the earth 's orbit (L2)and shall, due to the high collecting power of the Constellation-X telescopes, perform medium resolution (15 arc sec HEW) imaging of faint cosmic X-ray sources, as well as high-resolution spectroscopy[1].

A Constellation-X telescope is planned to have a focal length of 10 m, the mirror system will contain up to 90 tightly-nested Wolter 1 mirror shells, with diameters ranging from 400 to 1600 mm.

As each Constellation-X telescope shall be launched by a medium size (DELTA IV class) launcher, the mass budget requirements for the mirror system and therefore for the individual mirrors are very stringent, requiring light-weight, thin-walled mirror shells.

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In X-Ray Optics, Instruments, and Missions III, Joachim E. Trümper, Bernd Aschenbach, Editors, Proceedings of SPIE Vol. 4012 (2000) • 0277-786X/00/$15.00

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1 **System und Verfahren zur Herstellung von Mikrobauteilen**
Inventor: BINGEL ULRICH (DE); WEIS CHRISTOF (DE) Applicant: FRAUNHOFER GES FORSCHUNG (DE)
EC: IPC: B81C3/00
Publication info: **DE10302771** - 2004-08-05

2 **Production of a controlled deformable functional element comprises applying an actuator on an exposed metallic material surface of a metallic substrate, and surrounding the actuator**
Inventor: BINGEL ULRICH (DE); HOLECZEK HARALD (DE) Applicant: FRAUNHOFER GES FORSCHUNG (DE)
EC: H01L41/22; G02B26/08M; (+1) IPC: H02N2/00 ; H01L41/08 ; (+2)
Publication info: **DE10135962** - 2003-06-26

3 **Production of adapters used as a stent or blood vessel adapter in bypass surgery comprises forming a mold, coating with a metallic material, and dissolving the coating as adapter from the mold**
Inventor: BINGEL ULRICH (DE); STALLKAMP JAN (DE) Applicant: FRAUNHOFER GES FORSCHUNG (DE)
EC: A61F2/06C IPC: A61F2/06 ; A61M29/00 ; (+1)
Publication info: **DE10153542** - 2003-05-22

4 **Blood vessel adapter used as a stent or an anastomosis adapter in bypass surgery comprises a tubular piece having a passage between two axial end openings**
Inventor: BINGEL ULRICH (DE); STALLKAMP JAN (DE) Applicant: FRAUNHOFER GES FORSCHUNG (DE)
EC: A61F2/06C IPC: A61F2/06 ; A61M29/00 ; (+1)
Publication info: **DE10153541** - 2003-05-22

5 **Coating e.g. metal or plastics component involves electrolytic coating using non-aqueous or aprotic dispersant containing aluminum and/or magnesium compound and disperse phase, then anodic oxidation**
Inventor: BINGEL ULRICH (DE); FETZER HANS-JOCHEN (DE) Applicant: FRAUNHOFER GES FORSCHUNG (DE)
EC: IPC: C25D5/00 ; C25D11/02 ; (+1)
Publication info: **DE10134559** - 2003-02-06

6 **Electrode used for producing electrical field in galvanic bath for coating or removing metallic coatings on workpieces has deformation device for outer surface facing workpiece**
Inventor: BINGEL ULRICH (DE); GERTH CHRISTIAN (DE) Applicant: FRAUNHOFER GES FORSCHUNG (DE)
EC: C25F7/00; C25D17/12 IPC: C25D17/12 ; C25F7/00
Publication info: **DE10132408** - 2003-02-06

7 **Galvanoplastic optical mounting**
Inventor: BINGEL ULRICH (DE); HOLDERER HUBERT (DE); (+1) Applicant: ZEISS STIFTUNG (US)
EC: G02B7/02G; G02B7/02R IPC: C25D1/10
Publication info: **US6503383** - 2003-01-07

8 **Production of metals which foam on heat treatment or metal foams comprises suspending a propellant which splits gas on heat treatment in a galvanic electrolyte, and galvanically depositing the metal with the electrolyte on a substrate**
Inventor: BINGEL ULRICH (DE) Applicant: FRAUNHOFER GES FORSCHUNG (DE)
EC: C25C5/00 IPC: C25C5/00
Publication info: **DE10123585** - 2002-12-05

9 **OPTICAL BEAM GUIDE SYSTEM AND METHOD OF PREVENTING CONTAMINATION OF OPTICAL COMPONENTS CONTAINED IN SYSTEM**

Inventor: BINGEL ULRICH; DISTL JOSEF; (+2)
EC:
Applicant: ZEISS CARL SEMICONDUCTOR MFG
IPC: H01L21/027
Publication info: **JP2002270502** - 2002-09-20

10 Process reactor used in galvanizing processes comprises a container, and an intermediate wall which moves between a resting position partially outside of the container and a functional position partially inside of the container

Inventor: BINGEL ULRICH (DE); GERTH CHRISTIAN (DE)
EC:
Applicant: FRAUNHOFER GES FORSCHUNG (DE)
IPC: C25D17/02
Publication info: **DE10107674** - 2002-09-05

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11 METHOD FOR CONNECTING PLURALITY OF OPTICAL ELEMENT TO SUBSTRATE

Inventor: BINGEL ULRICH; MELZER FRANK — Applicant: ZEISS STIFTUNG

EC: — IPC: G02B5/10 ; C25D1/06 ; (+3)

Publication info: **JP2002071922** - 2002-03-12

7 = **12 Galvanoplastic optical mounting**

Inventor: BINGEL ULRICH (DE); HOLDERER HUBERT (DE); (+1) — Applicant: ZEISS STIFTUNG (DE)

EC: — IPC: G02B7/00

Publication info: **TW392084** - 2000-06-01

13 Metallmatrix-Hohlkugel-Kompositwerkstoff

Inventor: BINGEL ULRICH (DE); KAUFMANN PAUL (DE) — Applicant: ZEISS CARL FA (DE)

EC: — IPC: C22C32/00 ; C22C1/10 ; (+2)

Publication info: **DE59603669D** - 1999-12-23

13 = **14 Metal matrix composite containing hollow spheres**

Inventor: BINGEL ULRICH (DE); KAUFMANN PAUL (DE) — Applicant: ZEISS CARL (DE); ZEISS STIFTUNG (DE)

EC: C22C32/00; C22C32/00G — IPC: C22C32/00

Publication info: **EP0767246** - 1997-04-09

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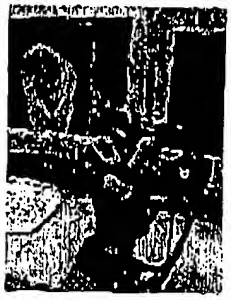

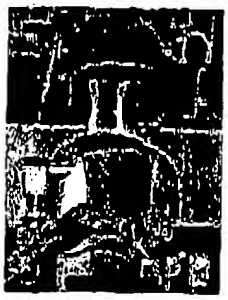

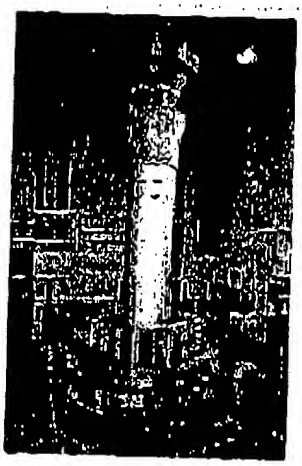

Surface Technology

New products and manufacturing methods place high innovative materials and processes. Here, coatings m electroplating and plasma technologies are often indis requirements of the properties and quality of the coati of the efficiency of the coating processes are steadily requirements can only be fulfilled by considering proc interfaces with other steps in the production chain fron view. The Department of Surface Technology develop complex techniques ranging from process developme planning and from their implementation in productions quality concepts.

Head of Department

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Merriam-Webster Online Dictionary

2 entries found for **between**.
To select an entry, click on it.

between[1,preposition]
between[2,adverb]
Go

Main Entry: [1]**be·tween**
Pronunciation: bi-'twEn
Function: *preposition*
Etymology: Middle English *betwene*, preposition & adverb, from Old English *betwEonum*, from *be-* + *-twEonum* (dative plural) (akin to Gothic *tweihnai* two each); akin to Old English *twA* two

1 a : by the common action of : jointly engaging <shared the work *between* the two of them> <talks *between* the three -- *Time*> **b** : in common to : shared by <divided *between* his four grandchildren>

2 a : in the time, space, or interval that separates **b** : in intermediate relation to

3 a : from one to another of <air service *between* Miami and Chicago> **b** : serving to connect or unite in a relationship (as difference, likeness, or proportion) <a one-to-one correspondence *between* sets> **c** : setting apart <the line *between* fact and fancy>

4 : in point of comparison of <not much to choose *between* the two coats>

5 : in confidence restricted to <a secret *between* you and me>

usage There is a persistent but unfounded notion that *between* can be used only of two items and that *among* must be used for more than two. *Between* has been used of more than two since Old English; it is especially appropriate to denote a one-to-one relationship, regardless of the number of items. It can be used when the number is unspecified <economic cooperation *between* nations>, when more than two are enumerated <*between* you and me and the lamppost> <partitioned *between* Austria, Prussia, and Russia -- Nathaniel Benchley>, and even when only one item is mentioned (but repetition is implied) <pausing *between* every sentence to rap the floor -- George Eliot>. *Among* is more appropriate where the emphasis is on distribution rather than individual relationships <discontent among the

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Thesaurus

One entry found for **indicate**.

Main Entry: **in·di·cate**
Pronunciation: 'in-d&-"kAt
Function: *transitive verb*
Inflected Form(s): **-cat·ed; -cat·ing**
Etymology: Latin *indicatus*, past participle of *indicare*, from *in-* + *dicare* to proclaim, dedicate -- more at DICTION
1 **a** : to point out or point to **b** : to be a sign, symptom, or index of <the high fever *indicates* a serious condition> **c** : to demonstrate or suggest the necessity or advisability of <*indicated* the need for a new school>
2 : to state or express briefly <*indicated* a desire to cooperate>

For More information on "indicate" go to Britannica.com
Get the Top 10 Search Results for "indicate"

Pronunciation Symbols

GALVANOPLASTIC OPTICAL MOUNTING

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an optical mounting for an optical component and more particularly to a high-precision optical mounting.

2. Discussion of Relevant Prior Art

Particularly high requirements are placed on optical mountings for satellite-borne systems. Low weight and high mechanical and thermal loading are required, with precise, stress-free mounting of the optical components. Examples of known solutions in this field of use are given in German Patent DE 296 03 024.4 U, and the state of the art cited therein.

Another field with particularly high requirements is microlithography. The projection exposure systems require the closest tolerances and the smallest strains, even in the presence of thermal effects, in order to attain extremes of imaging quality.

Metallic mountings are usually used in both fields of application, and are produced by machining in the broadest sense, including erosion, water-stream cutting, grinding, laser ablation and the like. Spring hinges and beams are then used in many variants as decoupling elements.

Galvanoplasty is a known technique for the production of thin-walled precision parts, even mirror optics, for example. Metal, usually aluminum or nickel or their alloys, is electrolytically deposited on a mold core that has been made electrically conductive with a thin layer. After the desired thickness has been reached, the galvanoplastic part is released from the mold core, using a difference in thermal expansion.

It is known from East German Patent DD 204 320 A to provide a lens with a positively fitting ring by galvanoplastic means, the ring being finish-turned for the centering of the lens and having surfaces by means of which the lens is received in a mounting. The closed ring, when thermally loaded, inevitably leads to stresses in the lens, due to the different thermal expansion.

SUMMARY OF THE INVENTION

The object of the invention is a high-precision mounting, which makes possible an optimum decoupling of the mounted optical component from stresses. A further object of the invention is to provide a favorable production process for the mounting.

These objects are attained with an optical mounting and a process having the following features:

An optical mounting for an optical component, comprising an inner portion abutting the optical component, an outer frame, and a plurality of galvanoplastically-produced spring hinge beams connecting together the inner portion and the outer frame.

A process for production of an optical mounting with spring hinge beams, includes placing a base for at least one portion of an optical mounting in an electrochemical apparatus and forming at least a portion of the optical mounting by galvanoplastic deposition.

The use of galvanoplasty makes it possible to produce a very delicate mounting with the greatest reproducible accuracy in few processing steps.

Electrochemical deposition is simultaneously used as a joining technique for adhesive-free connection to the

mounted optical part, and for integration of a solid part with a cross section that would be produced uneconomically by galvanoplasty.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in further detail with reference to the accompanying drawings, in which:

FIG. 1 shows a schematic overview of a galvanoplastic lens mounting;

FIG. 2 shows a schematic cross section of a mounting on a mold core in an electroplating apparatus; and

FIG. 3 shows in cross section a detail of the place of connection of the mounting and the lens.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. 1 shows a galvanoplastic lens mounting in the state after release from a mold core (mandrel).

An outer ring 3 is solid and rigid, due to a sheathed core 30, and is preferably provided with auxiliary means (not shown here), such as bores or grooves, for fastening in the overall optical housing. Webs 11, 12, 1*i* form thin spring beams that hold an inner ring 2 in its position centered with respect to the outer ring 3, but isolating from deformations of the outer ring, e.g., due to screwing to other parts, and likewise permitting, free from stress, deformations of the inner ring 2. Such deformations are brought about, for example, by the mounted optical component or by the connection thereto.

The webs 11, 12, 1*i* likewise permit relative diameter changes of the inner ring 2 and the outer ring 3, such as may arise due to thermal expansion when the temperature changes. For this purpose, the inner ring 2 is divided between the webs 11, 12, 1*i*, preferably after its release from the mold core, in a reactionless process such as laser cutting.

The inner ring 2 is preferably galvanoplastically produced as a closed ring, since this substantially withstands removal from the mold core by thermal shrinking. The divided inner ring is then connected individually at each segment 2*n* to the optical component (lens 7), and thus can take up its thermal expansion without stress. The segments 2*n* can also be simple continuations of the spring hinge beams 1*n*.

The thermal expansion of the outer ring 3 is determined by an integrated solid ring (30 in FIG. 2). The thermal expansion of the webs 11, 12, 1*i* (spring hinge beams) is determined by the electrochemically deposited material. By a suitable geometry (length of the webs, and angle of inclination to the plane of the rings 2, 3), it can be insured, in the manner known from U.S. Pat. No. 5,162,951 (cited in the above-mentioned German Patent DE 296 03 024.4 U), that the spacing of the inner and outer rings does not vary, or else varies in a desired manner. The mounting (1, 2, 3) can be seen in FIG. 2, in section on a mold core 4 in the electroplating apparatus.

The mold core 4 can consist of glass, which is coated by a thin film technique, e.g., by vapor deposition, sputtering, PVD, CVD, with an electrically conductive thin layer in the shape of the mounting, either structured by a mask or produced by etching after the surfaces that are to remain have been covered with a mask, which may be photolithographically produced, for example.

A mold core 4 of metal, precision turned, ground and polished, is shown here. It is provided with an insulating layer 41 at the perforations of the mounting (1, 2, 3), and thus between the webs 11, 12, 1*i*, 1*n*, in a manner corresponding to the glass mold core described hereinabove.

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◉ **Standard**	
Überschriften:	
○ Nein	◉ **Ja**
Resultatanzeige:	
◉ **Mit Gitter**	○ Ohne
Notationstoleranz:	
○ Groß	○ Strikt
◉ **Standard**	
Sprachversion:	
◉ **Deutsch**	○ **Englisch**

98 Treffer für 'zwischen'

ENGLISCH	DEUTSCH	
Unmittelbare Treffer		
among	zwischen	g d P
amongst	zwischen	g d P
between - *short: 'tween*	zwischen	g d P
betwixt	zwischen	g d P
in-between *prep.*	zwischen	g d P
inside *adj.*	zwischen	g d P
temporary *adj.*	zwischen	g d P
twixt [obs.]	zwischen	g d P
Verben und Verbzusammensetzungen		
to oscillate between	pendeln zwischen	g P
to toggle	schalten zwischen	g P
to differentiate between	unterscheidon zwischen	g P
to distinguish between	unterscheiden zwischen	g P
to ebb between sth.	zwischen etw. hin- und herschwanken	
to deal between parties [pol.]	zwischen Parteien verhandeln	g P

Legende

- d Definition, deutsch 4)
- e Zusatzinformation für 'Phrasal Verbs', englisch 1)
- f Forums-Diskussionen
- g Grammatik, deutsch 3)
- m Aussprache und Definition, englisch 2)
- o Orthographie, deutsch 3)
- P Aussprache, deutsch 5)
- v Variante, deutsch und englisch

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4): Basierend auf DWDS, Wörterbuch der Gegenwartssprache
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	[naut.]		
	inter-run undercut [tech.]	Längshub zwischen den Schweißraupen *[Schweißen]*	P
	interpass undercut [tech.]	Längshub zwischen den Schweißraupen *[Schweißen]*	P
	tribal factionalism	Querelen zwischen Stammesgruppen	
	sibling rivalry	Rivalität zwischen Geschwistern	P
	sandwich course [Brit.]	Teilstudium zwischen Betriebspraktika	P
	regional distinctions	Unterschiede zwischen den Gebieten	P
	bond bridge between the individual abrasive grits [tech.]	Verbindungssteg zwischen Schleifkörnern	P
m	treaty	Vertrag zwischen Regierungen	P
m	allotriodontia [med.]	Zahntransplantation zwischen Individuen	P
	interdepartmental cooperation	Zusammenarbeit zwischen den Abteilungen	P
	separation between storeys [tech.]	Abtrennung zwischen verschiedenen Geschossen - *Diebstahlsicherung*	P
	industrial relations *pl.*	Beziehung zwischen Arbeitgeber und Gewerkschaft *Pl.*	P
	industrial relations *pl.*	Beziehung zwischen Management und Gewerkschaft *Pl.*	P
V	labor relations	Beziehungen zwischen Arbeitgeber und Arbeitnehmer	P
V	labour relations	Beziehungen zwischen Arbeitgeber und Arbeitnehmer	P
	end-to-end flow control [tech.]	Flußkontroll-Prozedur zwischen Endpunkten	
	bilateral trade	Handel zwischen zwei Staaten	P
	clearance between	lichte Weite	P

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Überschriften:			
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Resultatanzeige:			
◉	**Mit Gitter**	○	Ohne
Notationstoleranz:			
○	Groß	○	Strikt
◉	**Standard**		
Sprachversion:			
◉	**Deutsch**	○	**Englisch**

18 Treffer für 'andeuten'

	ENGLISCH	DEUTSCH	
	Verben und Verbzusammensetzungen		
m	to adumbrate	andeuten	g d P
m	to betoken	andeuten	g d P
m	to denote	andeuten	g d P
m	to foretell	andeuten	g d P
m	to forshadow	andeuten	g d P
m	to get at sth.	etw. andeuten	g d P
m	to hint	andeuten	g d P
m	to indicate	andeuten	g d P
m	to insinuate	andeuten	g d P
m	to signify	andeuten	g d P
m	to suggest	andeuten	g d P
m	to suggest sth.	etw. andeuten	g d P
m	to adumbrate	im Umriss andeuten	Q g P
m	to foreshadow	im Voraus andeuten	Q g P
m	to adumbrate	leicht andeuten	g P
	to suggest a possibility	eine Möglichkeit andeuten	g P
m	to imply	stillschweigend andeuten	g P

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Resultatanzeige:			
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Notationstoleranz:			
○	Groß	○	Strikt
◉	**Standard**		
Sprachversion:			
◉	Deutsch	○	**Englisch**

1 Treffer für 'zwischenschicht'

ENGLISCH	DEUTSCH	
Unmittelbare Treffer		
intermediate layer [tech.]	die Zwischenschicht	g P

Legende

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